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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/071,207	02/11/2002	George Jonathan Kluth	52352-785	9267

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EXAMINER

GUERRERO, MARIA F

ART UNIT	PAPER NUMBER
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2822

DATE MAILED: 03/31/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/071,207

Applicant(s)

KLUTH ET AL.

Examiner

Maria Guerrero

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 January 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 19 and 20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 07 June 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 5.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

1. This Office Action is in response to the Preliminary amendment filed February 11, 2002 and the Election filed January 14, 2003.

Claims 1-20 are pending.

Election/Restrictions

2. Applicant's election of Group I claims 1-18 in Paper No. 8 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Claims 19-20 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 8.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-18 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "supersaturated" in claims 1 and 12 is a relative term, which renders the claims indefinite. The term "supersaturated" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the

invention. The limitation "forming supersaturated dopant concentration source/drain extensions in the substrate between the source/drain regions and the gate electrode" is indefinite because it is not clear how the supersaturated is defined in relation to the dopant concentration on the source/drain regions.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-3 and 5 are rejected under 35 U.S.C. 102(b) as being anticipated by Bai (U.S. 5,889,331) (as understood by the Examiner).

Bai teaches providing a semiconductor substrate (silicon) having an upper surface, a gate electrode formed on the upper surface of the substrate with a gate insulating layer therebetween, the gate electrode having an upper surface and source/drain regions (Fig. 5-7, col. 3, lines 50-65, col. 5, lines 20-30, 40-45). Bai discloses forming source/drain extensions having a dopant concentration, forming metal silicide contacts on the upper surface of the gate electrode and the substrate in a manner

sufficient to maintain the dopant concentration in the source/drain extensions (Fig. 7-9, col. 6, lines 15-20, 25-45).

In addition, Bai shows the temperature being below about 700°C throughout the forming of the metal silicide contacts (col. 6, lines 42-44). Bai discloses the metal silicide contacts being NiSi formed at a temperature of approximately 400-600°C (col. 6, lines 42-44). Bai teaches depositing a dielectric layer over the substrate and the gate electrode upper surfaces, patterning the dielectric layer to form sidewall spacers, depositing a nickel layer over the gate electrode, the substrate, and the sidewall spacers (Fig. 5-8, col. 5, lines 49-52). Bai discloses heating to react the nickel layer and form the nickel silicide (NiSi) contacts and removing the nickel that did not react to form the nickel silicide (Fig. 9, col. 6, lines 40-45).

5. Claims 1-3 and 6-7 are rejected under 35 U.S.C. 102(e) as being anticipated by Murthy et al. (U.S. 6,235,568) (as understood by the Examiner).

Murthy et al. teaches providing a silicon substrate having an upper surface, a gate electrode formed on the upper surface of the substrate with a gate insulating layer therebetween, the gate electrode having an upper surface and source/ drain regions (Fig. 1-2f, col. 4, lines 13-15, 40-50, col. 5, lines 10-20). Murthy et al. discloses forming source/drain extensions having a dopant concentration, forming metal silicide contacts on the upper surface of the gate electrode and the substrate in a manner sufficient to maintain the dopant concentration in the source/drain extensions (col. 6, lines 20-30, col. 9, lines 20-25).

In addition, Murthy et al. shows the temperature being below about 700°C throughout the forming of the metal silicide contacts (col. 9, lines 42-47). Murthy et al. discloses the metal silicide contacts being NiSi formed at a temperature of 400°C to about 700°C for approximately 20-30 seconds (col. 9, lines 22-30, col. 9, lines 42-47). Murthy et al. teaches a dopant concentration being about 10^{21} ions/cm³ by implanting a dosage about 1×10^{15} - 1×10^{16} atoms/cm² and an energy of between 30-80 keV (col. 6, lines 20-30).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 8-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murthy et al. (U.S. 6,235,568) in view of Tsukamoto (U.S. 5,399,506) (as understood by the Examiner).

Regarding claims 8-9, Murthy et al. does not specifically show exposing employing laser radiation with the specific energy as claimed. However, Tsukamoto shows employing laser radiation with an energy density ranging from 650 to 1100 nJ/cm² (Abstract, col. 3, lines 1-5, col. 4, lines 30-35).

Since Murthy et al. and Tsukamoto are both from the same field of endeavor of forming transistors; the purpose disclosed by Tsukamoto would have been recognized in the pertinent art of Murthy et al.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Murthy et al. reference by employing laser radiation as taught Tsukamoto in order to reduce leakage current (Tsukamoto, Abstract).

7. Claims 4 and 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) in view of Hsu (U.S. 5,491,099) (as understood by the Examiner).

Bai teaches providing a semiconductor substrate (silicon) having an upper surface, a gate electrode formed on the upper surface of the substrate with a gate insulating layer therebetween, the gate electrode having an upper surface and source/drain regions (Fig. 5-7, col. 3, lines 50-65, col. 5, lines 20-30, 40-45). Bai discloses forming source/drain extensions having a dopant concentration, forming metal silicide contacts on the upper surface of the gate electrode and the substrate in a manner sufficient to maintain the dopant concentration in the source/drain extensions (Fig. 7-9, col. 6, lines 15-20, 25-45).

In addition, Bai shows the temperature being below about 700°C throughout the forming of the metal silicide contacts (col. 6, lines 42-44). Bai discloses the metal silicide contacts being NiSi formed at a temperature of approximately 400-600°C (col. 6, lines 42-44). Bai teaches depositing a dielectric layer over the substrate and the gate electrode upper surfaces, patterning the dielectric layer to form sidewall spacers,

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depositing a nickel layer over the gate electrode, the substrate, and the sidewall spacers (Fig. 5-8, col. 5, lines 49-52). Bai discloses heating to react the nickel layer and form the nickel silicide (NiSi) contacts and removing the nickel that did not react to form the nickel silicide (Fig. 9, col. 6, lines 40-45).

Bai does not specifically show removing the spacers prior to forming the source/drain extensions. However, Hsu teaches removing the spacers prior to forming the source/drain extensions and forming a second insulating layer to form second sidewall spacers (Fig. 4-9, col. 3, lines 25-45, 56-60, col. 4, lines 3-20).

Since Bai and Hsu are both from the same field of endeavor of forming MOS devices, the purpose disclosed by Hsu would have been recognized in the pertinent art of Bai.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Bai's process by including the conventional step of removing the spacers as taught Hsu in order to reduce risk of hot electron reliability failures (Hsu, col. 2, lines 1-2).

8. Claims 10-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) in view of Ozturk et al. (U.S. 5,242,847) (as understood by the Examiner).

Regarding claims 10-11, Bai does not specifically show forming the source/drain extensions by doped selective epitaxy by applying a gas mixture comprising SiH₄, the temperature and pressure as claimed. However, Ozturk et al. teaches doping the

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substrate by selective epitaxy employing SiH_4 , employing the temperature of about 500°C to about 800°C and the pressure of 2.5 torr (col. 6, lines 20-30, col. 7, lines 18-25).

Since Bai and Ozturk et al. are both from the same field of endeavor of forming transistors, the purpose disclosed by Ozturk et al. would have been recognized in the pertinent art of Bai.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Bai's process by including the teaching of Ozturk et al. in order to form shallow doped regions (Ozturk et al., col. 3, lines 35-45).

9. Claims 14-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) and Hsu (U.S. 5,491,099) as applied to claims 12-13 above, and further in view of Ozturk et al. (U.S. 5,242,847) (as understood by the Examiner).

Regarding claims 14-15, the combination of Bai and Hsu does not specifically show forming the source/drain extensions by doped selective epitaxy by applying a gas mixture comprising SiH_4 , the temperature and pressure as claimed. However, Ozturk et al. teaches doping the substrate by selective epitaxy employing SiH_4 , employing the temperature of about 500°C to about 800°C and the pressure of 2.5 torr (col. 6, lines 20-30, col. 7, lines 18-25).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Bai and Hsu by including the teaching of Ozturk et al. in order to form shallow doped regions (Ozturk et al., col. 3, lines 35-45).

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10. Claims 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) and Hsu (U.S. 5,491,099) as applied to claims 12-13 above, and further in view of Tsukamoto (U.S. 5,399,506) (as understood by the Examiner).

Regarding claims 16-17, the combination of Bai and Hsu does not specifically show exposing employing laser radiation with the specific energy as claimed. However, Tsukamoto shows employing laser radiation with an energy density ranging from 650 to 1100 nJ/cm² (Abstract, col. 3, lines 1-5, col. 4, lines 30-35).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Bai and Hsu by employing laser radiation as taught Tsukamoto in order to reduce leakage current (Tsukamoto, Abstract).

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) and Hsu (U.S. 5,491,099) as applied to claims 12-13 above, and further in view of Murthy et al. (U.S. 6,235,568) (as understood by the Examiner).

Regarding claim 18, the combination of Bai and Hsu does not specifically show the dopant concentration being about 10²¹ ions/cm³. However, Murthy et al. teaches the concentration being 10²¹ ions/cm³ (col. 1, lines 60-65, col. 3, lines 40-46, col. 5, lines 10-15, col. 6, lines 20-30).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Bai and Hsu by specifying the concentration as taught Murthy et al. The modification would provide any desired concentration with a low thermal budget.

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Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Moslehi (U.S. 5,168,072) teaches doping by selective epitaxy. Nowak et al. (U.S. 6,426,278) teaches a laser dopant process fabrication of diffusion halos.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maria Guerrero whose telephone number is 703-305-0162.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 703-308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


Maria Guerrero
Patent examiner
March 21, 2003